Space Weather Technical Forecast

Issued on Monday, 04 March 2024 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-Class flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours, with a peak C3.1 flare at 03/1730UTC from ex-AR3590, which is now located beyond the northwest limb.

There are currently seven numbered and one un-numbered sunspot regions on the visible disc. AR3595 is the largest spot on the disk, with a large lead and trailer, but few other spots, and remains unchanged. AR3598 is a moderately complex bipolar group in the southwest, with a number of intermediate spots, although appears stable at this time. AR3892 has re-emerged to the east of AR3598, but is currently small and simple. The new region in the northeast is notable due to it's rapid emergence, but has since stabilised, yet this spot has a north-south magnetic alignment. The remaining regions are currently simple and stable.

A southward directed CME from around 03/1400 UTC has been analysed as potentially giving a glancing blow at Earth on 07 Mar. A smaller and more southward directed CME was observed in coronagraph imagery around 04/0430 UTC which is expected to miss Earth. A notable halo CME was observed in coronagraph imagery around 04/0700 UTC, but after investigation, this appears to be far sided. No further CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds parameters observed at L1 by ACE/DSCOVR indicated the ongoing then waning effects of one or more CMEs. Solar wind speeds were largely slow-ambient, around 330-390 km/s. Density was above average, peaking at 38ppcc at 03/1142 UTC before gradually falling to below average. Total magnetic field strength, IMF, was moderate to strong initially, with a peaks of 18nT (strong) during the second half of 03 March, then fell back to consistently Moderate during 04 March. The north-south component varied between +16/-18nT initially with sustained periods of negative Bz (southward) until 03/2300 UTC, after which it became mostly positive (northward). Phi angle fluctuated between negative (towards the Sun) and positive (away from the Sun) during 03 March before becoming predominantly positive (away from the Sun) during 04 March. G1-G2/Minor to Moderate storms were observed between 03/1200-2100 UTC, followed by two Active intervals (Kp 4) before eventually becoming Quiet (Kp 1) to end the period.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 04/0000UTC was 3.25e6 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is expected, with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: Waning CME effects continue to diminish on day 1 (04 Mar). A southward directed CME from 03 March may give glancing impacts on day 4 (07 Mar). Slow-ambient solar wind speeds are still being observed and are expected to remain at background levels with no significant enhancements anticipated during days 1-3 (04-06 Mar), glancing CME impacts on day 4 (07 Mar) may bring slightly elevated wind speeds at Earth. Quiet geomagnetic activity is expected throughout, with a chance of Unsettled to Active activity and a slight chance of G1/Minor Storms on day 1 (04 Mar) due to residual CME impacts, and again on day 4 (07 Mar) from glancing CME impacts.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to stay at background levels, but with a slight chance of rising above S1 levels on day 1 (04 Mar) in response to any notable flares, mainly from ex-AR3560 as this region rotates further around the far side. GOES16 high energy electron flux is expected to remain generally at background, occasionally moderate levels with the associated 24hr fluence remaining well below the Active threshold throughout.

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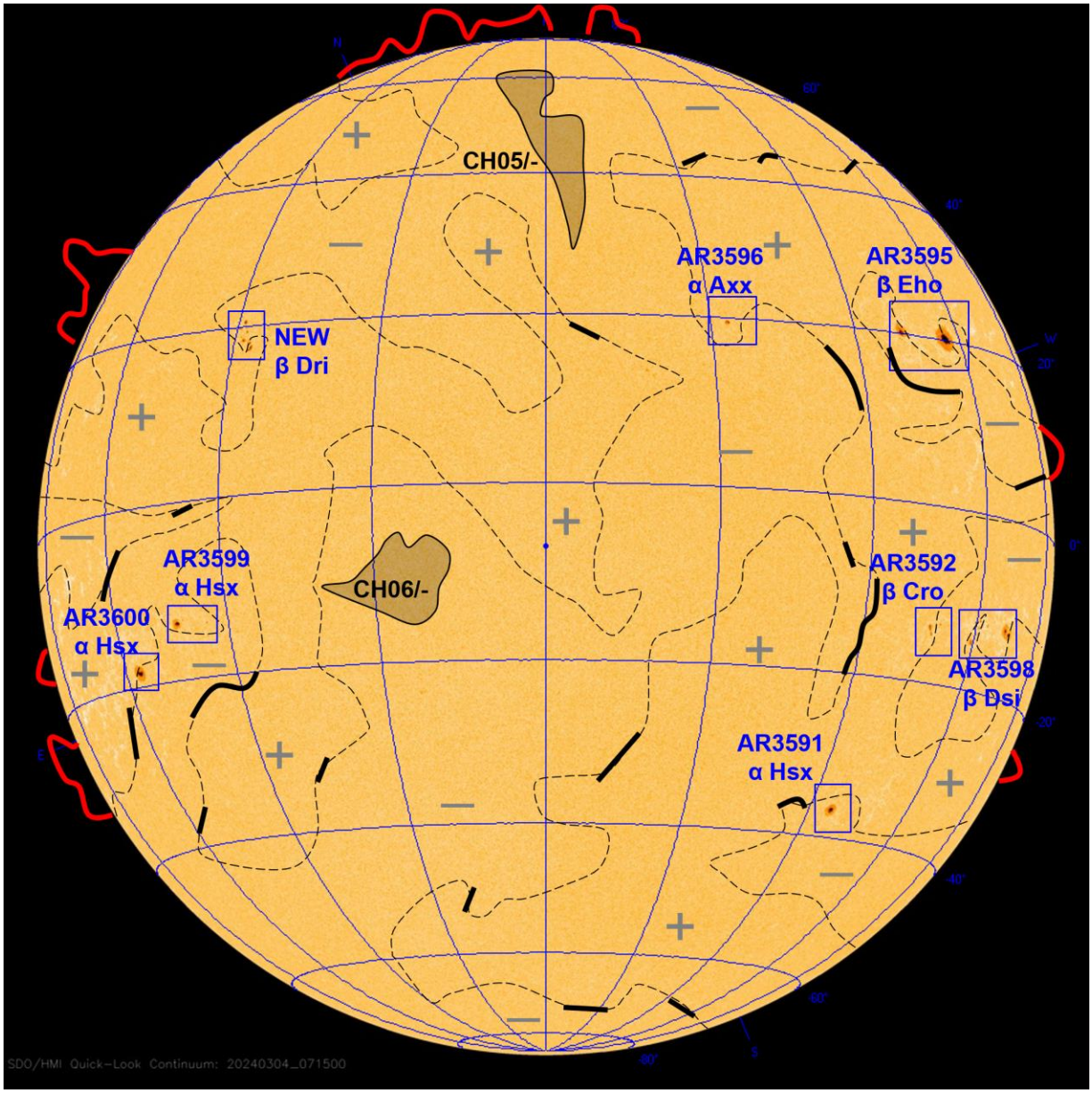
Figure 1. Solar Analysis Valid 04/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Ongoing effects from one or more CMEs that arrived at Earth early on 03 Mar should steadily diminish on day 1 (04 Mar). A southward directed CME from 03 March may give glancing impacts on day 4 (07 Mar).

Despite the CME arrival in the past 24 hours, slow-ambient solar wind speeds are still being observed at L1 and are expected to remain at background levels with no significant enhancements anticipated during days 1-3 (04-06 Mar), glancing CME impacts on day 4 (07 Mar) may bring slightly elevated wind speeds at Earth.

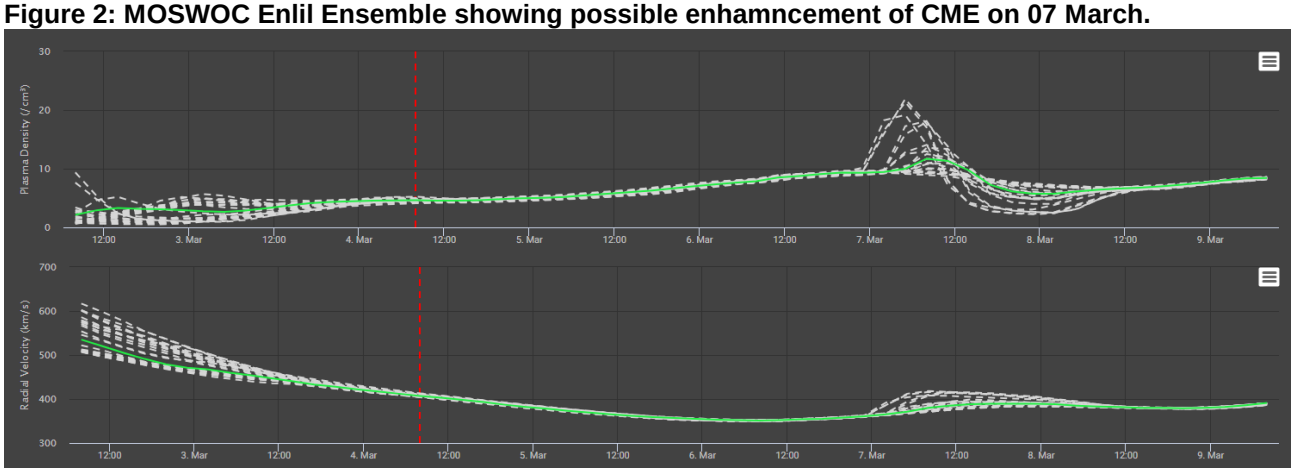
Quiet geomagnetic activity is expected throughout, with a chance of Unsettled to Active activity and a slight chance of G1/Minor Storms on day 1 (04 Mar) due to residual CME impacts, and again on day 4 (07 Mar) from glancing CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	5	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/1730 UTC	Partial	Filament	S	500 km/s	07/0600 UTC	Low confidence, glancing blow.

Figure 2: MOSWOC Enlil Ensemble showing possible enhamncement of CME on 07 March.



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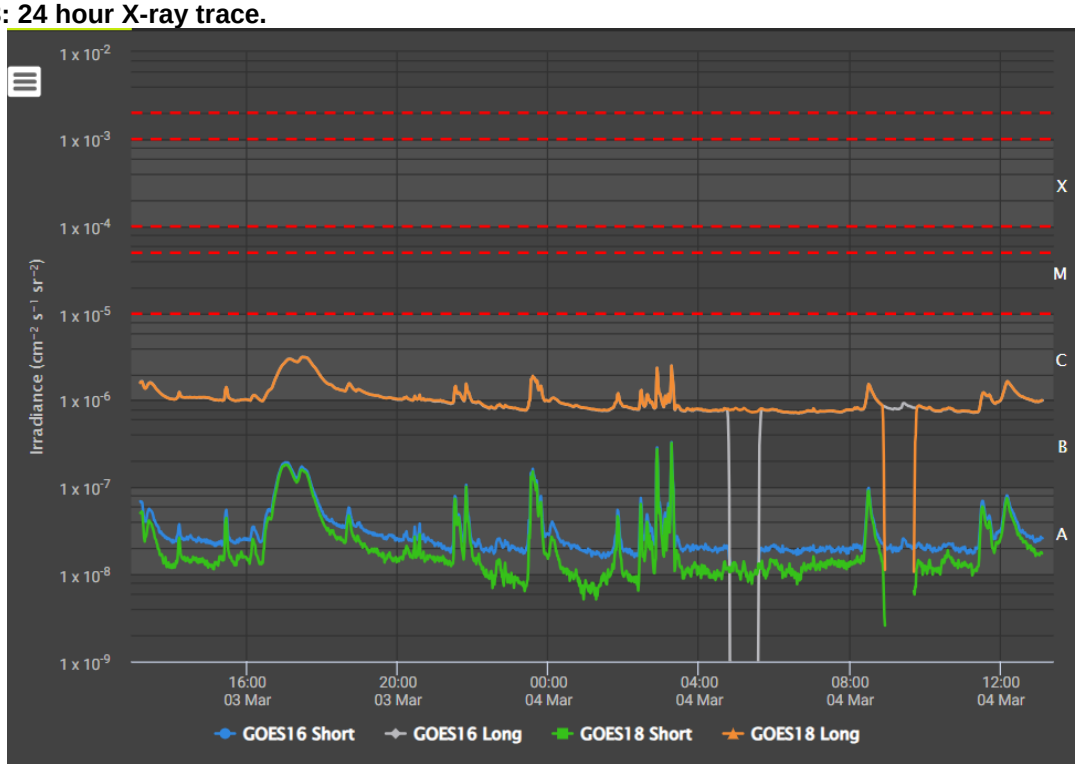
Radio Blackouts - X-Ray Flares:

There are currently seven numbered and one un-numbered sunspot regions on the visible disc. AR3595 is the largest spot on the disk, with a large lead and trailer, but few other spots, and remains unchanged. AR3598 is a moderately complex bipolar group in the southwest, with a number of intermediate spots, although appears stable at this time. AR3892 has re-emerged to the east of AR3598, but is currently small and simple. The new region in the northeast is notable due to its rapid emergence, but has since stabilised, yet this spot has a north-south magnetic alignment. The remaining regions are currently simple and stable.

Low activity is expected. AR3595, AR3598 and the New region in the northeast all carry similar risks of moderate-class flares, perhaps with some slight contribution from ex-AR3590 around the northwest limb. The risk will gradually decrease through the next 4 days as AR3560 continues to rotate around the far side of the disk, whilst AR3595 and AR3598 rotate onto the western limb. Further active region/s are expected to rotate onto the eastern limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	30	25	25
Very Active	R3 to R5 X Class	No	5	1	1	1

Figure 3: 24 hour X-ray trace.



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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background levels, and is likely to remain so through the period. There is just a slight chance of enhancement from any major flare associated with ex-AR3590 from the far side of the northwest limb, with this risk decreasing through the next 24 hours.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	2	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

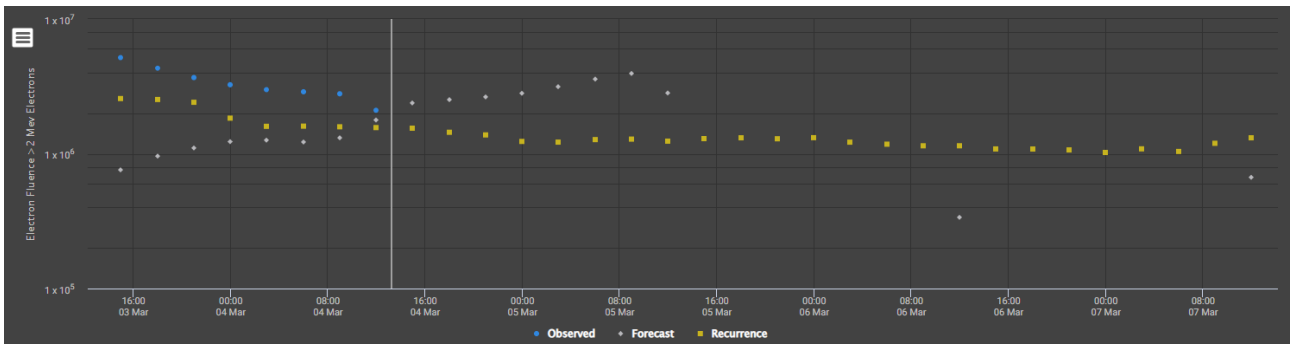
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to remain generally at background, occasionally moderate levels in the absence of any significant solar wind inputs.

Corresponding high energy electron fluence is expected to remain well below the Active threshold (1e8 integrated pfu).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM showing fluence observations/forecast/recurrance.



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